Estimation of the Joint Patient Condition Occurrence Frequencies from Operation Iraqi Freedom and Operation Enduring Freedom

Volume 1: Development of Methodology

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This research was conducted in compliance with all applicable federal regulations governing the protection of human subjects in research.

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Summary

The Joint Services Capabilities Plan requires that each service provide—and periodically update—their respective patient condition occurrence frequency (PCOF) tables used for requirements estimation. The Joint Medical Analysis Tool (JMAT), version 2.0, lacked current service PCOFs. Accordingly, the Assistant Secretary of Defense for Health Affairs (ASD/HA), Force Health Protection & Readiness (FHP&R), commissioned the development of Joint PCOF tables for the Joint Medical Analysis Tool.

Medical planners often use modeling and simulation programs such as JMAT to obtain statistically valid estimates for medical services, equipment, and supplies. Access to electronic health records kept in the U.S. Central Command Theater of Operations provided a prime opportunity to perform an analysis on Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), and provided the underlying data to generate the needed POCFs in JMAT.

PCOF distributions quantify the occurrence probabilities of different injury and illness types. These injury estimates, in turn, enable the estimation of needed medical services, equipment, and supplies. Updated PCOF estimates, based on recent operational data, increase the accuracy of patient load and injury profiles and reflect improvements in protective gear, forward-level surgery capabilities, preventative health measures, and types of operations. Empirical data from U.S. combat operations in OEF and OIF provide a rich informational source to aid in calculating OEF and OIF PCOF distributions. However, no single database existed that captured patient data for casualties moving from point of injury through the medical system to definitive care. To support this study, various data sets from OEF and OIF were combined into a “hybrid” database to combine the strengths of individual data sources and provide a more comprehensive representation of the patient’s treatment profile.

The Department of Defense Military Health System requires the use of *International Classification of Diseases,* 9th Revision (ICD-9) diagnostic codes to characterize injuries and illnesses for medical planning purposes during military operations. The Defense Medical Material Program Office (DMMPO)—formerly known as the Defense Medical Standardization Board—initially adopted 336 ICD-9 diagnostic codes for their baseline. However, empirical patient encounter data contain several thousand ICD-9 codes that are not contained in this DMMPO subset. To overcome this mismatch, a rigorous, repeatable, and statistical process was used to map the larger set of ICD-9 codes to the subset recognized by the DMMPO.

This technical report describes the methodology that was used to estimate the occurrence rates of the 336 DMMPO ICD-9 codes. These diagnostic codes comprise the Joint Services PCOF tables. These PCOF tables are provided by casualty type (wounded in action, nonbattle injury, disease, and combat stress casualties) and for three different scenarios (OEF, OIF, and the 2004 Fallujah operation during OIF).

The use of recent empirical data establishes an updated baseline for estimating future medical needs on the battlefield. The results of this study will be provided to ASD/HA, FHP&R to help plan future medical force requirements.

Background

The Joint Services Capabilities Plan requires that each service provide, and periodically update, their respective patient condition occurrence frequency (PCOF) tables. Historically, this has been accomplished using committee-developed patient condition (PC) codes, and these tables were seldom updated. Due to the lack of current service PCOFs, the Assistant Secretary of Defense for Health Affairs (ASD/HA), Force Health Protection & Readiness (FHP&R) commissioned this PCOF study on Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF).

In the past, PC codes provided an abbreviated method of describing patient trauma and illness, and a standardized manner of describing required treatments across services. PC codes were introduced to help determine the types of medical specialties, medical capabilities, supplies, and evacuation assets needed at each level of care to execute the medical mission. They described the illnesses and injuries most likely to occur during military operations. These codes were refined and modernized several times under the direction of the Joint Services Clinical Review Group, currently the Defense Medical Materiel Program Office (DMMPO).

Each PC code is accompanied by a narrative description and the projected courses of treatment at each level of care. PC narratives provide a clinical picture of treatments and allow the data to be modeled in Time, Task, Treater (TTT) files within the Deployable Medical Systems clinical database (currently called the Common User Database) and the Estimating Supplies Program (ESP) (Tropeano, Daly, Pang, & Konoske, 2001).

The PC treatment brief is the basis of the Common User Database. It specifies the who (provider), what (patient presentation), where (level of care), why (medical condition), and how (equipment and supplies) of medical treatment. The TTT file takes the information contained in

the treatment brief and translates it into a database based on the time, personnel, supplies, equipment, and tasks to be done for each patient malady over a 24-hour period. Currently, it is the DMMPO's responsibility to standardize treatment materiel.

In the course of its research work, the Naval Health Research Center refined, enhanced, and developed additional PC treatment briefs from TTT files to calculate the medical requirements for treating a particular patient distribution and tracking inventory at additional functional areas not clearly defined or stated in the TTT files. This information provided the basis for the development of ESP, which allows users to assess supply use across levels of care for ground and shipboard medical facilities, and across all medical functional areas.

Using PC codes, PCOFs were generated to estimate the illness and injury distributions for wounded in action (WIA), nonbattle (NBI), disease (DIS), and combat stress casualty (CSC) injuries. Casualty rates applied to the casualty distribution generate realistic, simulated casualty streams, and are the essential planning factors required for medical resource requirement estimations.

Recently, the DMMPO mandated the use of *International Classification of Diseases*, Ninth Revision (ICD-9) codes, replacing the committee-based PC codes, to characterize injuries and illnesses for medical planning purposes in building PCOF tables. This paper describes the methodology for developing Joint PCOF tables based on the DMMPO mandated list of ICD-9 codes.

Introduction

Accurate medical resource requirement forecasting during military operations is contingent upon obtaining reliable estimates of the likely casualty occurrences and the expected types of illnesses and injuries. These estimates include determination of the overall WIA, NBI,

DIS, and CSC incidence rates, and the distribution of injuries and illnesses for the likely patient streams described by the PCOFs. The PCOFs should be updated periodically, based on recent operational data, to accurately depict patient load and update injury profiles that reflect the improvements of protective gear, forward-level surgery capabilities, and preventative health measures (Holcomb, Stansbury, Champion, Wade, & Bellamy, 2006). Empirical data from the U.S. combat operations OEF and OIF provide a rich informational source to aid in estimating the Joint PCOF distributions. However, no single database existed which captured patient data as casualties moved from point of injury through the medical system to definitive care. Accordingly, to support this study, various data sets from OEF and OIF were combined into a "hybrid" database to combine the strengths of each data source, and provide a more comprehensive representation of patient treatment profiles.

Casualty rates, when applied to the PCOF distributions, form representative patient streams. These are entered into medical performance models to determine requirements for medical supplies, personnel, and medical capabilities to support theater-level medical force planning. Such estimates can be adjusted for operation types and phases, and geographical differences.

Historically, PCOFs have been expressed in terms of PC codes grouped into the larger WIA, DIS, NBI, and CSC categories. Since recent empirical data is recorded as ICD-9 codes, it is logical to use the ICD-9 standardized coding schema to update PCOF tables. Accordingly, DMMPO adopted a list of 336 ICD-9 diagnostic codes to do this. However, empirical patient encounter data contain several thousand ICD-9 codes and are not confined to this subset. To overcome this mismatch, a rigorous, statistical process was used to map this large set of diagnostic codes to the restricted set recognized by the DMMPO. To represent multiple injury

wounds, DMMPO included an additional 47 codes that were combinations of the 336 codes (a total of 383 DMMPO codes). A description of the methodology for developing Joint PCOF tables based on the DMMPO mandated list of ICD-9 codes is the focus of this report.

Methodology

Overview

To develop, analyze, and refine patient workload, particular aspects of the PCOF distributions must be understood. Separate grouping methodologies were developed to estimate PCOF distributions for WIA, NBI, DIS, and CSC. The Barell matrix (BM) (Clark & Ahmad, 2006) classification of injuries was used to compare and estimate PCOFs for WIA and NBI. The major diagnostic categories—formed by dividing all possible principal diagnoses (from ICD-9) into 25 mutually-exclusive diagnosis categories—were used to map DIS PCOFs. Finally, CSC estimates were developed by rolling up mental disease-related ICD-9s into the associated DMMPO ICD-9 categories. The electronic health record was only partially populated in the early phases of OEF and OIF. Therefore, this study reviewed records dated between Janurary1, 2004 and December 31, 2009.

Developing the hybrid database

For analytical purposes, a hierarchical approach was developed to describe and define specific subpopulations within the patient workload. This approach enhanced analysis accuracy. Essentially, the process of developing updated PCOF tables consisted of two steps: merging all relevant data and constructing a hybrid database, and mapping empirical ICD-9 codes from source databases to the restricted DMMPO ICD-9s. Since no single data source exists that was able to track casualties through all levels of care, a hybrid database was created using data from several sources identified later in this report. The Theater Medical Data Store (TMDS) was

selected as the most representative Joint services data set, with other data sources supplementing the ICD-9 codes in the TMDS. The hybrid database and the data sets used to build it are discussed in more detail below.

Mapping billable ICD-9 codes to DMMPO ICD-9 codes

The DMMPO adopted 336 ICD-9 and 47 multiple injury ICD-9 codes as representative descriptors of the injuries and diseases most likely to occur during a military deployment. The empirical database reflects the much broader set of ICD-9 codes actually used by clinicians to describe actual casualty treatment. A search of relevant databases showed that they contain only billable ICD-9 codes (codes through which services may be billed to patients because they represent tasks and supplies), and that there were many more ICD-9 codes used (approximately 1,600) than were contained in the subset approved by the DMMPO (only 336, and this list contains both billable and non-billable codes).

The much larger set of codes had to be mapped to the DMMPO subset, and this was the challenge: to derive accurate PCOF tables from a hybrid database (one which combines several source databases to provide a more comprehensive view of patient flow) while characterizing only the DMMPO ICD-9 subset of codes. In addition, the process to accomplish this must be rigorous and repeatable.

Data Sources

Empirical data from U.S. combat operations OEF and OIF provide a rich informational source to aid in estimating the Joint PCOF distributions. Unfortunately, these data are dispersed across several medical databases that are designed to fill niche documentation requirements for the medical mission. Accordingly, available data sources were combined to create a comprehensive, sole-source view that tracks individual patients from point of injury to definitive

care for each event. The resulting hybrid database contains all relevant information from each data set. In summation, it provides information that is not available in any other single data source; it is a more comprehensive representation of casualty evacuation and treatment status.

TMDS

In concert with ASD/HA, the TMDS was chosen as the primary database in developing the hybrid database. The TMDS is a Web-based patient tracking and management tool that collects and reports patient treatments, transfers, and dispositions. The TMDS provides evaluation of the casualties across the spectrum of care, from forward theater to the rear. Various reporting modules provide data to TMDS including: the Joint Patient Tracking Application, Global Expeditionary Medical System, the Transportation Command Regulating and Command and Control Evacuation System, the Composite Health Care System, the Armed Forces Health Longitudinal Technology Application-Theater (AHLTA-T), and the Shipboard Non-tactical Automatic Data Processing Program Automated Medical System. These reporting modules communicate to the TMDS through the use of a service-oriented architecture, known as the Theater Medical Information Program Framework.

All reporting modules in the TMDS were used in the development of the hybrid database, however, the majority of outpatient records were obtained from AHLTA-T and the majority of inpatient records were obtained from the Joint Patient Tracking Application. The TMDS captures data for military personnel, civilians, foreign nationals, and foreign military nationals. However, the hybrid database included only military personnel deployed in support of OEF and OIF.

Military personnel deployed in support of OEF and OIF were identified by matching patients from the TMDS to the Defense Manpower Data Center deployment file. As additional

verification, the receiving medical treatment facility where the patient was treated (as denoted in the TMDS) was also used.

The hybrid database's primary fields are: casualty type (WIA, NBI, and DIS), primary ICD-9 diagnosis, encounter date, reporting module, disposition status, and place of injury (OEF or OIF). While comprehensive, the ICD-9 codes in the TMDS are not all validated by medical coders. To improve ICD-9 code reliability, additional data sources were merged into the TMDS. Only medical admission records were validated from the additional data sources.

The ambulatory outpatient visit (OPV) data were primarily medical records obtained from the AHLTA-T module, and could not be found in the other data sources. The OPV records represented relatively minor conditions seen at the Level 1 and 2 medical treatment facilities. Due the large number of these records, a separate casualty type was established and is now referred to as OPV. Separate PCOFs will be developed for OPVs.

Other Sources

The Standard Inpatient Data Record (SIDR) and Standard Ambulatory Data Record (SADR) are the official electronic Department of Defense military data records for inpatients and outpatients respectively. Data validation and verification is completed on a regular basis. SIDR and SADR provided data on patients who were evacuated out of theater, primarily to the Landstuhl Regional Medical Center in Germany, and then to the continental U.S. The ICD-9 diagnoses from SIDR and SADR, which are entered by clinicians, are more accurate than the TMDS. Thus, data used to populate the primary fields of the hybrid database was taken from SIDR and SADR records, even though one of the limitations of SIDR and SADR is that additional data sources are required to identify casualties who were injured in OEF or OIF.

The U.S. Army obtains inpatient data from theater-level combat support hospitals in Iraq and Afghanistan through the Patient Administration Systems and Biostatistics Activity (PASBA). Certified medical personnel then code the hospital records from combat support hospitals by ICD-9 and procedure codes. Each patient can be assigned up to 20 ICD-9 and procedure codes.

The Expeditionary Medical Encounter Database (EMED), formerly known as the Navy-Marine Corps Combat Trauma Registry (Galarneau et al., 2006), is a data warehouse composed of data sets that describe casualty events from the point of injury, through the medical chain of evacuation, and on to long-term rehabilitative care. The EMED contains very detailed information on ICD-9 diagnoses and casualty types. Similar to PASBA data, all ICD-9 codes captured in the EMED are validated by certified medical coders. The data sources that were matched to the TMDS are shown below.

1. Primary data source (TMDS):
    a. Inpatient records ICD-9 coded unique records (2004-2009)
    b. Outpatient records ICD-9 coded unique records (2004-2009)
2. Secondary data sets (the following data sets matched to the TMDS inpatient records):
    a. SADR
    b. SIDR
    c. PASBA
    d. EMED

As more data become available, future PCOF estimates will not be limited to the databases above.

Developing the Hybrid Database

As stated previously, no single data source existed that tracked patients from the point of injury, through acute care, and on to definitive care. Therefore, various data sets were used to develop a comprehensive hybrid database that capitalizes on individual database strengths. The hybrid database provides a single, more-accurate, highly-representative database that can be used to estimate medical requirements across the spectrum of care. The level of care covered by each database is shown in Figure 1. To form the hybrid database, patient data are merged by patient identification and encounter date. This includes data from Level 1 and 2 (forward levels of care), Level 3 (theater-level hospitalization), and Level 4 (outside the continental U.S. hospitalization).

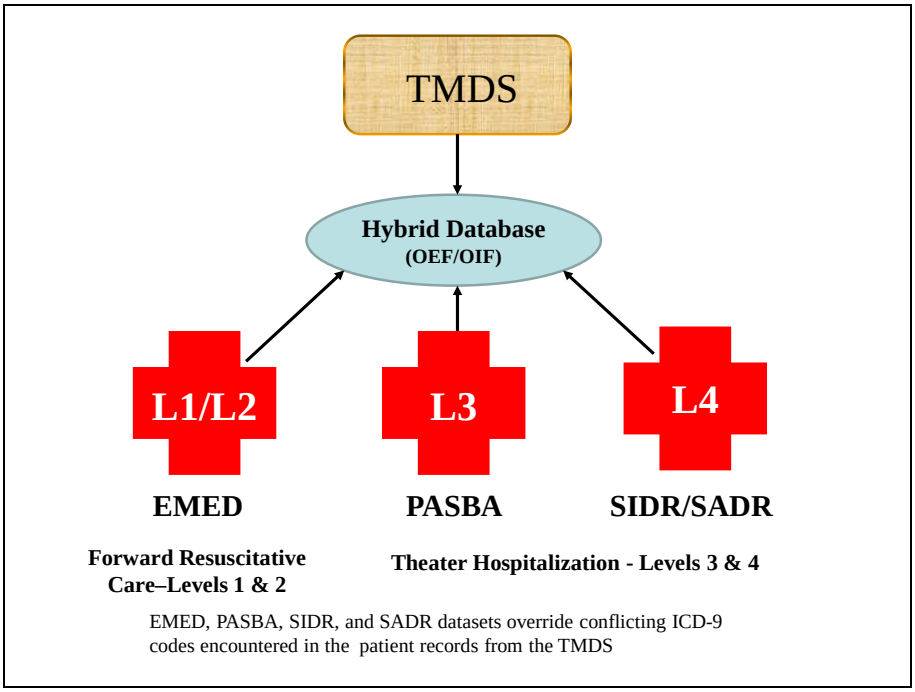

Figure 1. A conceptual view of the hybrid database data sources.

Reliability of the hybrid database

The TMDS was the most comprehensive database capturing data from OEF and OIF, and was the primary data source used in estimating the PCOF tables. However, coding of the data is done automatically by an application based on a diagnosis entered by the provider. TMDS data

coding is not reviewed by certified medical coders. On the other hand, all ICD-9 codes in the EMED, SIDR, and SADR are validated by medical coders; these sources supplanted the TMDS ICD-9 in cases of disagreement. The accuracy of the EMED, SADR, and SIDR—combined with the inclusivity of the TMDS—provided a robust database while effectively improving the actual ICD-9 codes.

Operational phases

Different military operations, and distinctive periods within them, can result in varied distributions of injury and disease occurrence. To examine different patterns for casualty incidence, four operational phases were initially proposed: OEF in Afghanistan, OIF in Iraq, the Fallujah operation of OIF in the November–December 2004 timeframe (representing a higher intensity operation in an urban setting), and OIF excluding the Fallujah operation. Since the casualty PCOF distributions for the full OIF operation and the OIF operation excluding Fallujah proved to be quite similar, the OIF operation excluding Fallujah was omitted, and PCOF tables were generated for the three operational phases shown in Table 2.

Table 1

PCOF Operational Phases from OEF and OIF

Phase	**Representative period**
OEF[a]	Jan 2004–Dec 2009
OIF[a]	Jan 2004–Dec 2009
Fallujah[b]	Nov 2004–Dec 2004 (only participating units)

[a]TMDS data were not available prior to Jan 2004. [b]Participating U.S. Marine and Army personnel were identified by Unit Identification Codes.

Mapping Source Database Injury ICD-9 Codes to DMMPO ICD-9 Codes

The Billable ICD-9 codes contained in the databases are diagnosis codes used by clinicians and medical practitioners for billable services. Billable ICD-9 codes are the only type found in the databases. The 336 ICD-9 diagnosis codes defined by the DMMPO are a subset of the "billable" ICD-9 codes found in the data sets. The challenge was to develop a rigorous, repeatable process to derive PCOF tables limited to the DMMPO ICD-9 subset from supporting databases containing the full range of billable ICD-9 codes. The following steps summarize the process to derive PCOF tables for the DMMPO ICD-9 codes:

1. Identify billable ICD-9 codes that map exactly to the DMMPO ICD-9 diagnosis codes, and for those that don't map one-to-one, match the broader set of associated ICD-9s to the appropriate DMMPO ICD-9. Approximately 1,600 billable ICD-9 codes were matched to the 336 DMMPO ICD-9 codes. For example, as shown in Table 2, ICD-9 code 005 (food poisoning) is contained in the DMMPO ICD-9 subset, but eight ICD-9 codes—which are billable and extant in the data sets—correlate to code 005.
2. Compute PCOF estimates for the billable ICD-9 codes as represented in the hybrid database.
3. Sum the PCOF estimates for billable ICD-9 codes into the "parent" 336 DMMPO ICD-9 codes.

Approximately 1,600 support database ICD-9 codes were matched to the 336 DMMPO ICD-9 codes. An example appears in Table 2 . The DMMPO ICD-9 code 005 (food poisoning) is mapped to eight source database ICD-9 codes. Note that on average, five billable ICD-9s

mapped to a single DMMPO ICD-9 code. The largest number of billable ICD-9 codes mapped to a single DMMPO ICD-9 code was 60.

Table 2

Example ofICD-9 Code 005, Food Poisoning and Associated Billable ICD-9s

DMMPO ICD-9 code	Billable ICD-9 codes	Description
ICD-9 code 005 food poisoning	005.0	Staphylococcal food poisoning
	005.1	Botulism food poisoning
	005.2	Food poisoning due to clostridium perfringens
	005.3	Food poisoning due to other clostridia
	005.4	Food poisoning due to vibrio parahaemolyticus
	005.81	Food poisoning due to vibrio vulnificus
	005.89	Other bacterial food poisoning
	005.9	Food poisoning unspecified

Injury (WIA and NBI) PCOF Methodology

Separate methodologies were developed to estimate PCOF distributions for WIA, NBI, DIS, and CSC. For WIA and NBI, the Barell matrix (BM) was used to map billable ICD-9 codes to the DMMPO subset. The BM is a standardized method for classifying injuries that is recognized by the National Center for Health Statistics and the Centers for Disease Control and Prevention. The BM is a two-dimensional array that assigns ICD-9 codes describing trauma (800-995) by anatomical location and trauma category. A slight modification was made to the BM in order to specify fractures as either open or closed.

To estimate individual DMMPO ICD-9s, the strategy was to assign each ICD-9 code to a BM cell, and then distribute its frequency count to one of the DMMPO ICD-9 codes based on: (1) an exact match, (2) a three-digit ICD-9 match, or (3) a many-to-one match. The BM provided a sound and repeatable method when there was no straightforward process to assign ICD-9 codes from the empirical data to the DMMPO code set. The BM was used as a filtering mechanism for mapping the empirical data to the DMMPO ICD-9 codes, and each DMMPO ICD-9 code was assigned to its respective BM cell. Table 3 shows the BM category for sprains and strains; comparing a subset of DMMPO ICD-9 codes (11 total) to the BM ICD-9 codes (44 total). The table in Appendix B shows the complete groupings for each DMMPO ICD-9 code and equivalent BM designations.

Table 3

Classification of the Sprains and Strains DMMPO ICD-9 Codes into the BM

DMMPO ICD-9 codes		**BM ICD-9 codes**	**Anatomical location**
840.4 840.9	Rotator cuff sprain Sprain, shoulder/not otherwise specified	840.0-840.9	Shoulder upper arm
843	Sprains and strains of hip and thigh	843.0, 843.1, 843.8, 843.9	Hip
844.9	Sprain knee	844.0-844.3 844.8-844.9	Knee
845	Ankle sprain	845.00-845.03, 845.9, 845.10-845.13, 845.19	Lower leg/ankle
846.0 846.1	Sprains and strains of sacroiliac region Lumbosacral (joint) (ligament) sprain	846.0-846.3, 846.8-846.9, 848.5	Pelvis
847.2	Lumbar sprain	847.2	Lumbar
847.3	Sprain of sacrum	847.3-847.4	Sacrum/coccyx
848.1	Jaw sprain	848.0-848.1	Face
848.3	Sprain of ribs	848.3-848.4	Chest

Supplemented BM

To more accurately describe combat trauma, a slight modification was made to the BM to specify fractures as either open or closed (see Appendix B). Fractures historically account for approximately 20% of combat trauma. By classifying fractures as open or closed, more reliable medical resource estimates are possible (Zouris, Wade, & Magno, 2008). This was easily accomplished by examining the fourth and fifth digits of the ICD-9 codes in the empirical data, and assigning fractures as either open or closed.

In a similar manner, the burns category in the BM could easily be expanded to account for varying degrees of burn. In addition, the large number of traumatic brain injuries occurring in OEF and OIF has prompted preliminary work to expand the BM to account for four levels of traumatic brain injuries, instead of the three current classifications (Wojcik, 2009).

Mapping the empirical data BM ICD-9 codes to the DMMPO ICD-9 codes

Determination on how to map the empirical BM ICD-9 to the DMMPO ICD-9 is governed by one of the three following occurrences:

1. A one-to-one mapping exists. For example, an empirical or BM ICD-9 840.4 is mapped to DMMPO ICD-9 840.4.
2. Several empirical ICD-9 codes map to a single DMMPO ICD-9 For example, the empirical ICD-9 codes 885.0–885.7 would map to DMMPO ICD-9 885. In this case, all instances of empirical data in the 885.0–885.7 range would be rolled up into the DMMPO ICD-9 885.

A difficulty arises when an empirical ICD-9 does not map directly to a DMMPO ICD-9. The BM permits this mapping through a robust and repeatable process. In Table 3, for example, empirical ICD-9 code 840.5, which describes dislocation to the arm, cannot be definitively

assigned to either DMMPO ICD-9 code 840.0 or 840.9. Using the BM to distribute the empirical data to the restricted set of DMMPO ICD-9 codes accomplishes this mapping. In simple cases, the data are assigned uniformly—such that if the empirical data contained 10 instances of ICD-9 840.5, five would be attributed to each of the DMMPO ICD-9 codes. However, in more complex cases, a weighting algorithm was used to ensure that certain DMMPO ICD-9 codes reflected the empirical data.

If an empirical BM ICD-9 does not map to a DMMPO ICD-9 code:

a. Empirical ICD-9 840.5 would equally map to both DMMPO ICD-9 840.0 and 840.9. This implies that 50% of data would be assigned to 840.0 and 50% would be assigned to 840.9.
b. Empirical ICD-9 846.8 would map to both DMMPO ICD-9 846.0 and 846.1. Based on the empirical data, 846.1 is four times more likely to occur—so 80% is applied to 846.0 and 20% is applied to 846.1.

Empirical ICD-9 diagnoses outside the BM range

All casualty-type designations were obtained as reported by the TMDS, and the BM categorizes injury ICD-9 codes in the range of 800–995. When diagnoses outside this BM range were encountered (these were primarily musculoskeletal disorders, often the result of NBI), that portion of the empirical data was carried directly into the PCOF table. For example, ICD-9 717.0 (internal derangement of knee) was often the result of NBI, however, ICD-9 code 717.0 could not be categorized using the BM, so it was carried directly over in the development of the PCPF tables.

DIS PCOF Table Methodology

Major diagnostic categories (MDC) were used to map DIS ICD-9 codes in the hybrid database to the DMMPO DIS ICD-9 diagnosis codes. MDC are a list of 25 mutually-exclusive diagnostic categories that cover all possible DIS-related ICD-9 codes. The diagnoses in each MDC correspond to a single organ system, and in general, are associated with a particular medical specialty. Therefore, all the individual ICD-9 codes falling within a specific MDC would likely use similar resources, even if those resources varied in amount.

DIS ICD-9 codes are outside the range of 800–995 (which describe injury or trauma; WIA and NBI). Just as DMMPO trauma codes are a subset of all possible empirical codes, so are DMMPO DIS codes a subset, and they required a different mapping procedure. PCOF DIS tables (in each operational phase) were computed using the following steps:

1. Map the ICD-9 codes to MDC categories for all ICD-9 codes, and for the DMMPO ICD-9 codes in the hybrid database.
2. Exclude MDC with no mapped DMMPO ICD-9 codes from analysis.
3. Compute the frequency distribution of all the ICD-9 DIS codes found in the hybrid database.
4. Compute the frequency distribution of DMMPO ICD-9 codes for each MDC.
5. For each MDC group, reweight individual DMMPO ICD-9 code percentages to match the overall MDC group percentage as indicated by the empirical data.
6. Use DMMPO ICD-9 reweighted percentages to construct the DIS PCOF tables.

Figure 2 illustrates an example of DIS PCOF tables derived using MDC mapping, as applied to the OEF dataset. The example is for MDC #2 (diseases and disorders of the eye). The table on the left shows all the diagnoses found in the empirical data for MDC #2 (79 patients in

this example). (Note: The hybrid database contained 4,050 OEF patients in all MDC categories.) The third column shows that while there were a total of 24 distinct eye-related diagnoses, only nine of these diagnoses were included in the DMMPO ICD-9 codes. These nine diagnostic instances total 0.44% of all the occurrences in the hybrid database. However, MDC #2 accounts for 1.95% (79/4,050) of the occurrences. Thus, the nine DMMPO ICD-9 codes were recomputed by weighting them in proportion to the overall incidence of MDC #2. The reweighted ICD-9s totaled 1.95%, the empirical group percentage.

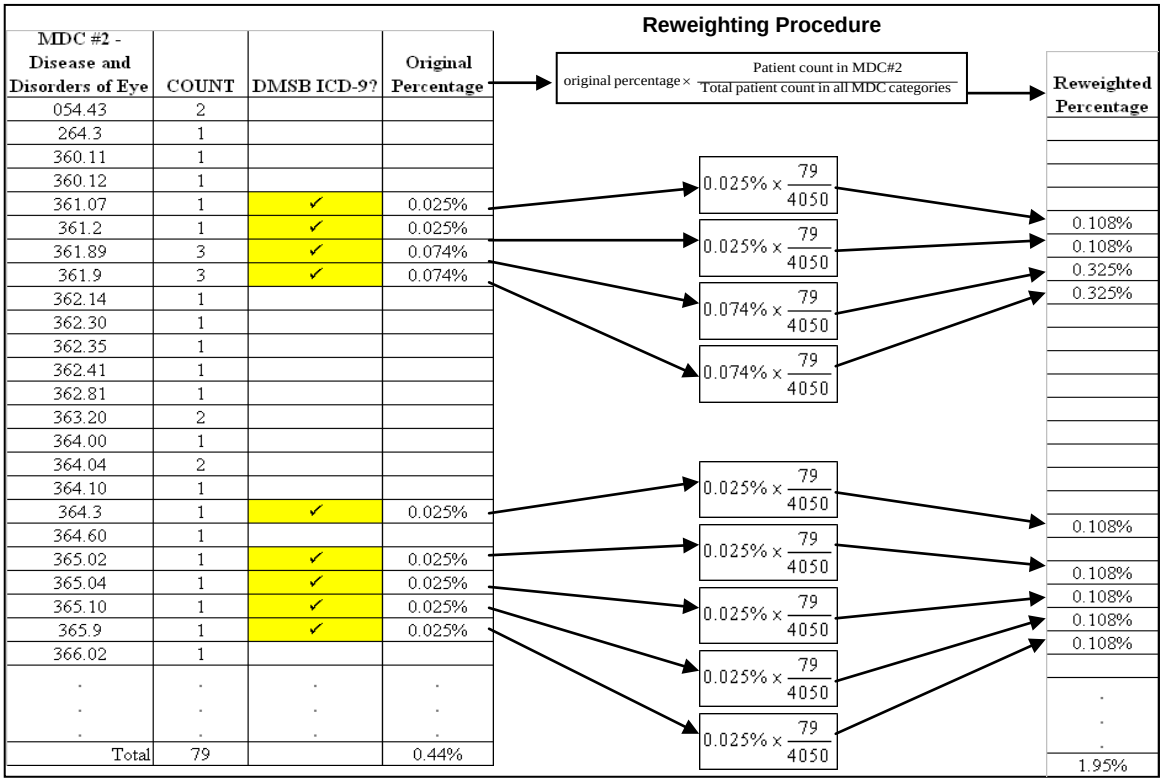

Figure 2. Derivation of DIS PCOF tables with MDC mapping using the category diseases and disorders of eye.

CSC Methodology

The CSC category is a subset of DIS. In the literature, various factors have been postulated as contributing to combat stress and its effects have been debated, but there is no widespread agreement on the symptomatic description, diagnosis, or cause of combat stress (MacGregor, 2009). While no standardized CSC definition exists, for purposes of the

methodology it can largely be thought of as representing the Mental Diseases and Disorders MDC category.

Table 4 shows the CSC-eligible ICD-9 codes from the DMMPO list as representing CSC-types of conditions. For this group of codes, distributions were calculated from the hybrid database. The ICD-9 codes selected for this study were the billable codes in the range obtained from the Mental Diseases and Disorders MDC, as well as ICD-9 codes 780 and 780.5.

Table 4

Common Combat Stress Symptoms

ICD-9 code	Description
296	Bipolar disorder, single manic episode
298.9	Unspecified psychosis
309	Adjustment reaction with adjustment disorder
309.81	Post traumatic stress disorder
309.9	Unspecified adjustment reaction
310.2	Postconcussion syndrome
780	Alterations of consciousness
780.5	Sleep disturbances

Limitations

- Not all ICD-9 codes found in the TMDS database were matched to the records in the EMED, SADR, or SIDR databases.
- PCOF table estimates are based on a casualty's primary diagnoses. Injury profiles for patients suffering multiple injuries will not be fully represented in the data.

- The reported PCOF estimates are derived from combat operations and do not represent the full range of military operations including disaster relief, peacekeeping, or humanitarian assistance.
- Sick call visits are often not captured by reporting systems, and may not be reflected in the PCOF estimates.
- Some combat stress ICD-9 codes are reported both as DIS PCOFs and CSC PCOFs. CSC historically has not been well reported, thus PCOF estimates may not reflect the true proportions of this condition.

Summary

The process described in this technical report provides a robust, repeatable methodology suited for updating PCOF baselines. The methodology used here to derive PCOF tables for the Joint services is cogent, repeatable, and can be used for combat operations by any of the services for WIA, NBI, DIS, and CSC. An expanded version of the BM was used to map injuries (WIA and NBI). The BM is a standardized method for classifying injuries and is recognized by the National Center for Health Statistics. Using the expanded BM in conjunction with a weighting algorithm provided a repeatable process to estimate the limited set of DMMPO ICD-9 codes. The WIA methodology was based on the relationship of injury type and anatomical location. The NBI methodology was also based on the injury type and anatomical location, but environmentally-dependent injuries—like musculoskeletal disorders and heat or cold injuries—are also included.

MDC were used to derive DIS PCOF estimates. The MDC are a group of 25 mutually-exclusive principal diagnosis categories that correspond to a single organ system, and in general, are associated with a particular medical specialty. All ICD-9 codes falling within a specific MDC

would likely use similar resources, even if those resources varied in amount. The disease methodology maps all DIS ICD-9 codes in the DMMPO list to MDC. A weighting algorithm was used to precisely estimate the percentage of incidence for each disease DMMPO ICD-9 code.

Deriving accurate PCOF tables for combat stress is complicated by the fact that, historically, behavioral health issues have not been well reported. Combat stress-eligible ICD-9 codes were identified from the DMMPO list using subject matter expert knowledge and referencing published work on posttraumatic stress disorder and other combat-related psychological disorders. The empirical proportions of each combat stress-eligible ICD-9 code in the hybrid database were used for CSC PCOF estimates.

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Appendix A.
List of Acronyms

Acronym	Description
AHLTA-T	Armed Forces Health Longitudinal Technology Application–Theater
BM	Barell matrix
CSC	combat stress casualty
DIS	disease
DMMPO	Defense Medical Standardization Board
EMED	Expeditionary Medical Encounter Database
ESP	Estimating Supplies Program
ICD-9	*International Classification of Diseases,* 9th Revision
KIA	killed in action
MDC	major diagnostic categories
NBI	nonbattle injury
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OPV	outpatient visits
PASBA	patient administration systems and biostatistics activity
PC	patient condition
PCOF	patient condition occurrence frequency
SADR	Standard Ambulatory Data Record
SIDR	Standard Inpatient Data Record
TMDS	Theater Medical Data Store
TTT	Time, Task, Treater files
WIA	wounded in action

Appendix B.
Statistical Underpinnings

Table

Barell Matrix ICD-9 Injury Classifications

DMMPO ICD-9 codes	Trauma category	Anatomical location
800 Closed Fracture of Vault of Skull without Intracranial Injury	FRAC CL	TYPE 2 TBI
801 Closed Fracture of Base of Skull without Intracranial Injury	FRAC CL	TYPE 2 TBI
802 Closed Fracture of Nasal Bones	FRAC CL	FACE
802.6 Fracture Orbital Floor closed (blowout)	FRAC CL	FACE
802.8 Closed Fracture of Other Facial Bones	FRAC CL	FACE
805 Closed Fracture of Cervical Vertebra without Spinal Cord Injury	FRAC CL	CERVICAL VCI
806.2 Closed Fracture of Dorsal Vertebra with Spinal Cord Injury	FRAC CL	THORACIC/DORSAL SCI
806.4 Closed Fracture of Lumbar Spine with Spinal Cord Injury	FRAC CL	LUMBAR SCI
806.6 Closed Fracture Sacrum and Coccyx with Unspecified Spinal Cord Injury	FRAC CL	SACRUM COCCYX SCI
807 Closed Fracture of Ribs	FRAC CL	CHEST
807.2 Closed Fracture of Sternum	FRAC CL	CHEST
808.8 Fracture of Pelvis Unspec, Closed	FRAC CL	PELVIS+UROGENITAL
810 Clavicle Fracture, Closed	FRAC CL	SHOULDER & UPPER ARM
811 Fracture of Scapula, Closed	FRAC CL	SHOULDER & UPPER ARM
812 Fracture of Unspecified Part of Upper End of Humerus, Closed	FRAC CL	SHOULDER & UPPER ARM
813.8 Fracture of Unspecified Part of Radius and Ulna, Closed	FRAC CL	FOREARM & ELBOW
815 Closed Fracture of Metacarpal Bones	FRAC CL	HAND & WRIST & FINGERS
816 Phalanges Fracture, Closed	FRAC CL	HAND & WRIST & FINGERS
817 Multiple Closed Fractures of Hand Bones	FRAC CL	HAND & WRIST & FINGERS
820.8 Femur, Neck Fracture, Closed	FRAC CL	HIP
821.01 Fracture Femur Shaft, Closed	FRAC CL	UPPER LEG & THIGH

DMMPO ICD-9 codes	Trauma category	Anatomical location
822 Closed Fracture of Patella	FRAC CL	KNEE
823.82 TIB/FIB Fracture, Closed	FRAC CL	LOWER LEG & ANKLE
824.8 Ankle Fracture, Closed	FRAC CL	LOWER LEG & ANKLE
825 Fracture of Calcaneous Closed	FRAC CL	FOOT & TOES
826 Closed Fracture of One or More Phalanges Foot	FRAC CL	FOOT & TOES
829 Fracture of Unspecified Bone Closed	FRAC CL	UNSPECIFIED
801.76 Open Fracture Base of Skull with Subarach, Subdural, Extradural Hem	FRAC OP	TYPE 1 TBI
802.1 Open Fracture of Nasal Bones	FRAC OP	FACE
802.7 Fracture Orbital Floor Open (blowout)	FRAC OP	FACE
802.9 Open Fracture of Other Facial Bones	FRAC OP	FACE
806.1 Open Fracture of Cervical Vertebra with Spinal Cord Injury	FRAC OP	CERVICAL SCI
806.3 Open Fracture of Dorsal Vertebra with Spinal Cord Injury	FRAC OP	THORACIC/DORSAL SCI
806.5 Open Fracture of Lumbar Spine with Spinal Cord Injury	FRAC OP	LUMBAR SCI
806.7 Open Fracture Sacrum and Coccyx with Unspecified Spinal Cord Injury	FRAC OP	SACRUM COCCYX SCI
807.1 Open Fracture of Ribs	FRAC OP	CHEST
807.3 Open Fracture of Sternum	FRAC OP	CHEST
808.9 Fracture of Pelvis Unspec, Open	FRAC OP	PELVIS+UROGENITAL
810.1 Clavicle Fracture, Open	FRAC OP	SHOULDER & UPPER ARM
810.12 Open Fracture of Shaft of Clavicle	FRAC OP	SHOULDER & UPPER ARM
811.1 Fracture of Scapula, Open	FRAC OP	SHOULDER & UPPER ARM
813.9 Fracture of Unspecified Part of Radius with Ulna Open	FRAC OP	FOREARM & ELBOW
816.1 Phalanges Fracture, Open	FRAC OP	HAND & WRIST & FINGERS
817.1 Multiple Open Fracture of Hand Bones	FRAC OP	HAND & WRIST & FINGERS
820.9 Femur Neck Fracture, Open	FRAC OP	HIP

DMMPO ICD-9 codes	Trauma category	Anatomical location
821.11 Fracture Femur Shaft, Open	FRAC OP	UPPER LEG & THIGH
822.1 Open Fracture of Patella	FRAC OP	KNEE
823.9 Fracture of Unspecified Part of Tibia and Fibula Open	FRAC OP	LOWER LEG & ANKLE
824.9 Ankle Fracture, Open	FRAC OP	LOWER LEG & ANKLE
830 Closed Dislocation of Jaw	DISLOCATION	FACE
830.1 Open Dislocation of Jaw	DISLOCATION	FACE
831 Dislocation Shoulder	DISLOCATION	SHOULDER & UPPER ARM
831.04 Closed Dislocation of Acromioclaviular Joint	DISLOCATION	SHOULDER & UPPER ARM
831.1 Open Dislocation of Shoulder	DISLOCATION	SHOULDER & UPPER ARM
832 Dislocation Elbow, Closed	DISLOCATION	FOREARM & ELBOW
832.1 Dislocation Elbow, Open	DISLOCATION	FOREARM & ELBOW
833 Wrist Dislocation, Closed	DISLOCATION	HAND & WRIST & FINGERS
833.1 Wrist Dislocation, Open	DISLOCATION	HAND & WRIST & FINGERS
834 Dislocation Finger, Closed	DISLOCATION	HAND & WRIST & FINGERS
834.1 Dislocation Finger, Open	DISLOCATION	HAND & WRIST & FINGERS
835 Closed Dislocation of Hip	DISLOCATION	HIP
835.1 Hip Dislocation Open	DISLOCATION	HIP
836 Medical Meniscus Tear Knee	DISLOCATION	KNEE
836.1 Lateral Meniscus Tear Knee	DISLOCATION	KNEE
836.2 Meniscus Tear of Knee, NOS	DISLOCATION	KNEE
836.5 Dislocation Knee, Closed	DISLOCATION	KNEE
836.6 Other Dislocation of Knee Open	DISLOCATION	KNEE
839.01 Closed Dislocation First Cervical Vertebra	DISLOCATION	CERVICAL VCI[c]
840.4 Rotator Cuff Sprain	SPRAINS & STRAINS	SHOULDER & UPPER ARM

DMMPO ICD-9 codes	Trauma category	Anatomical location
840.9 Sprain, Shoulder/Army NOS	SPRAINS & STRAINS	SHOULDER & UPPER ARM
843 Sprains and Strains of Hip and Thigh	SPRAINS & STRAINS	HIP
844.9 Sprain Knee	SPRAINS & STRAINS	LOWER EXTREMITY
845 Ankle Sprain	SPRAINS & STRAINS	LOWER LEG & ANKLE
846 Sprains and Strains of Sacroiliac Region	SPRAINS & STRAINS	PELVIS+UROGENITAL
846 Lumbosacral (Joint) (Ligament) Sprain	SPRAINS & STRAINS	PELVIS+UROGENITAL
847.2 Lumbar Sprain	SPRAINS & STRAINS	LUMBAR VCI[c]
847.3 Sprain of Sacrum	SPRAINS & STRAINS	SACRUM COCCYX VCI[c]
848.1 Jaw Sprain	SPRAINS & STRAINS	FACE
848.3 Sprain of Ribs	SPRAINS & STRAINS	CHEST
850.9 Concussion	INTERNAL ORGAN	TYPE 2 TBI
851 Cortex Contusion, without Open Intracranial Wound Concus Inspec	INTERNAL ORGAN	TYPE 1 TBI
851.01 Cerebral Contusion without Open Wound No Loss of Consciousness	INTERNAL ORGAN	TYPE 1 TBI
852 Subarachnoid Subdural Extradural Hemorrhage Injury	INTERNAL ORGAN	TYPE 1 TBI
853 Other and Unspecified Intracranial Hemorrhage Injury without Open Wound	INTERNAL ORGAN	TYPE 1 TBI
853.15 Unspecified Intracranial Hemorrhage with Open Intracranial Wound	INTERNAL ORGAN	TYPE 1 TBI
860 Traumatic Pneumothorax without Open Wound into Thorax	INTERNAL ORGAN	CHEST
860.1 Traumatic Pneumothorax with open Wound into Thorax	INTERNAL ORGAN	CHEST
860.2 Traumatic Hemothorax without Open Wound into Thorax	INTERNAL ORGAN	CHEST
860.3 Traumatic Hemothorax with open Wound into Thorax	INTERNAL ORGAN	CHEST
860.4 Traumatic Pneumohemothorax without Open Wound into Thorax	INTERNAL ORGAN	CHEST
860.5 Traumatic Pneumohemothorax with open Wound Into Thorax	INTERNAL ORGAN	CHEST
861 Injury to Heart without Open Wound into Thorax	INTERNAL ORGAN	CHEST
861.1 Unspecified Injury of Heart with Open Wound into Thorax	INTERNAL ORGAN	CHEST

DMMPO ICD-9 codes	Trauma category	Anatomical location
861.2 Lung Injury without Open Wound into Thorax	INTERNAL ORGAN	CHEST
861.3 Lung Injury with Open Wound into Thorax	INTERNAL ORGAN	CHEST
863 Injury to Stomach without Open Wound into Cavity	INTERNAL ORGAN	ABDOMEN
864.1 Unspecified Injury to Liver with Open Wound into Cavity	INTERNAL ORGAN	ABDOMEN
865 Injury to Spleen	INTERNAL ORGAN	ABDOMEN
866 Injury Kidney without Open Wound	INTERNAL ORGAN	ABDOMEN
866.1 Injury to Kidney with Open Wound Into Cavity	INTERNAL ORGAN	ABDOMEN
867 Injury to Bladder Urethra	INTERNAL ORGAN	PELVIS+UROGENITAL
867.1 Injury to Bladder Urethra with Open Wound into Cavity	INTERNAL ORGAN	PELVIS+UROGENITAL
867.2 Injury to Ureter without Open Wound into Cavity	INTERNAL ORGAN	PELVIS+UROGENITAL
867.3 Injury to Ureter with open Wound into Cavity	INTERNAL ORGAN	PELVIS+UROGENITAL
867.4 Injury to Uterus without Open Wound into Cavity	INTERNAL ORGAN	PELVIS+UROGENITAL
867.5 Injury to Uterus with open Wound into Cavity	INTERNAL ORGAN	PELVIS+UROGENITAL
870 Open Wound of Ocular Adnexa	OPEN WOUNDS	EYE
870.3 Penetrating Wound of Orbit without Foreign Body	OPEN WOUNDS	EYE
870.4 Penetrating Wound of Orbit with Foreign Body	OPEN WOUNDS	EYE
871.5 Penetration of Eyeball with Magnetic Foreign Body	OPEN WOUNDS	EYE
872 Open Wound of Ear	OPEN WOUNDS	FACE
873.4 Open Wound of Face without Mention of Complication	OPEN WOUNDS	FACE
873.8 Open Head Wound without Complications	OPEN WOUNDS	OTHER HEAD
873.9 Open Head Wound with Complications	OPEN WOUNDS	OTHER HEAD
874.8 Open Wound of Other Unspecified Parts of Neck without Complications	OPEN WOUNDS	NECK
875 Open Wound of Chest Wall without Complication	OPEN WOUNDS	CHEST
876 Open Wound of Back without Complication	OPEN WOUNDS	BACK+BUTTOCK

DMMPO ICD-9 codes	Trauma category	Anatomical location
877 Open Wound of Buttock without Complication	OPEN WOUNDS	PELVIS+UROGENITAL
878 Open Wound of Genital Organs (ext) including Traumatic Amputation	OPEN WOUNDS	PELVIS+UROGENITAL
879.2 Open Wound of Abdominal Wall Anterior without Complication	OPEN WOUNDS	ABDOMEN
879.6 Open Wound Other Unspecified Parts Trunk without Complication	OPEN WOUNDS	TRUNK
879.8 Open Wound(s) (Multiple) of Unspecified Site(s) without Complication	OPEN WOUNDS	UNSPECIFIED
880 Open Wound Shoulder Upper Arm	OPEN WOUNDS	SHOULDER & UPPER ARM
881 Open Wound Elbow, Forearm, Wrist	OPEN WOUNDS	FOREARM & ELBOW
882 Open Wound Hand Except Fingers Alone	OPEN WOUNDS	HAND & WRIST & FINGERS
883 Open Wound of Fingers without Complication	OPEN WOUNDS	HAND & WRIST & FINGERS
884 Multiple and Unspecified Open Wound of Upper Limb without Complication	OPEN WOUNDS	UPPER EXTREMITY
885 Traumatic Amputation of Thumb (complete, Partial)	AMPUTATIONS	HAND & WRIST & FINGERS
886 Traumatic Amputation of Other Finger(s) (Complete, Partial)	AMPUTATIONS	HAND & WRIST & FINGERS
887 Traumatic Amputation of Arm and Hand (Complete, Partial)	AMPUTATIONS	FOREARM & ELBOW
890 Open Wound of Hip and Thigh	OPEN WOUNDS	LOWER EXTREMITY
891 Open Wound Knee, Leg (except thigh) and Ankle	OPEN WOUNDS	LOWER EXTREMITY
892 Open Wound Foot, except toes, alone without Complications	OPEN WOUNDS	FOOT & TOES
894 Multiple and Unspecified Open Wound of Lower Limb without Complications	OPEN WOUNDS	LOWER EXTREMITY
895 Traumatic Amputation of Toe(s) (Complete, Partial)	AMPUTATIONS	FOOT & TOES
896 Traumatic Amputation of Foot (Complete) (Partial)	AMPUTATIONS	FOOT & TOES
897 Traumatic Amputation of Leg(s) (Complete, Partial)	AMPUTATIONS	LOWER LEG & ANKLE
903 Injury to Blood Vessels of Upper Extremity	BLOOD VESSELS	UPPER EXTREMITY
904 Injury to Blood Vessels of Lower Extremity and Unspecified Sites	BLOOD VESSELS	LOWER EXTREMITY
910 Abrasion/Friction Burn of Face/Neck/Scalp/Eye without Infection	SUPERFIC/CONT	HEAD,FACE,NECK UNSPECIFIED
916 Abrasion/Friction Burn of Hip/Thigh/Leg/Ankle without Infection	SUPERFIC/CONT	LOWER EXTREMITY

DMMPO ICD-9 codes	Trauma category	Anatomical location
916.1 Abrasion/Friction Burn of Hip/Thigh/Leg/Ankle with Infection	SUPERFIC/CONT	LOWER EXTREMITY
916.2 Blister of Hip, Thigh, Leg, Ankle, without Infection	SUPERFIC/CONT	LOWER EXTREMITY
916.3 Blister of Hip/Thigh/Leg/Ankle Infected	SUPERFIC/CONT	LOWER EXTREMITY
916.4 Insect Bite Non venomous Hip, Thigh, Leg, Ankle, without Infection	SUPERFIC/CONT	LOWER EXTREMITY
916.5 Insect Bite Non Venomous Hip, Thigh, Leg, Ankle with Infection	SUPERFIC/CONT	LOWER EXTREMITY
918.1 Superficial Injury Cornea	SUPERFIC/CONT	EYE
920 Contusion of Face, Scalp, and Neck Except Eye(s)	SUPERFIC/CONT	HEAD,FACE,NECK UNSPECIFIED
921 Black Eye Not Otherwise Spec	SUPERFIC/CONT	EYE
922.1 Contusion of Chest Wall	SUPERFIC/CONT	CHEST
922.2 Contusion of Abdominal Wall	SUPERFIC/CONT	ABDOMEN
922.4 Contusion of Genital Organs	SUPERFIC/CONT	PELVIS+UROGENITAL
924.1 Contusion of Knee and Lower Leg	SUPERFIC/CONT	LOWER LEG & ANKLE
924.2 Contusion of Ankle and Foot	SUPERFIC/CONT	FOOT & TOES
924.3 Contusion of Toe	SUPERFIC/CONT	FOOT & TOES
925 Crushing Injury of Face, Scalp, & Neck	CRUSHING	HEAD,FACE,NECK UNSPECIFIED
926 Crushing Injury of Trunk	CRUSHING	PELVIS+UROGENITAL
927 Crushing Injury of Upper Limb	CRUSHING	SHOULDER & UPPER ARM
928 Crushing Injury of Lower Limb	CRUSHING	UPPER LEG & THIGH
930 Foreign Body on External Eye	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
935 Foreign Body in Mouth, Esophagus, and Stomach	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
941 Burn of Face, Head, Neck	BURNS	HEAD,FACE,NECK UNSPECIFIED
942 Burn of Trunk, Unspecified Degree	BURNS	TRUNK
943 Burn of Upper Limb Except Wrist and Hand Unspecified Degree	BURNS	UPPER EXTREMITY
944 Burn of Wrist(s) and Hand(s)	BURNS	HAND & WRIST & FINGERS

DMMPO ICD-9 codes	Trauma category	Anatomical location
945 Burn of Lower Limb(s)	BURNS	LOWER EXTREMITY
950 Injury to Optic Nerve and Pathways	NERVES	EYE
953 Injury to Cervical Nerve Root	NERVES	NECK
953.4 Injury to Brachial Plexus	NERVES	UPPER EXTREMITY
955 Injury to Axillary Nerve	NERVES	UPPER EXTREMITY
956 Injury to Sciatic Nerve	NERVES	OTHER,MULTIPLE,NEC
959.01 Other and Unspecified Injury to Head	UNSPECIFIED	OTHER HEAD
959.09 Other and Unspecified Injury Face and Neck	UNSPECIFIED	UNSPECIFIED
959.7 Other and Unspecified Injury to Knee, Leg, Ankle, Foot	UNSPECIFIED	LOWER EXTREMITY
989.5 Toxic Effect of Venom	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
989.9 Toxic Effect of Unspecified Substance Chiefly Non-medicinal	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
991.3 Frostbite	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
991.6 Hypothermia	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
992 Heat Stroke and Sun Stroke	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
992.2 Heat Cramps	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
992.3 Heat Exhaustion Anhydrotic	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994 Effects of Lightning	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.1 Drowning and Nonfatal Submersion	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.2 Effects of Deprivation of Food	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.3 Effects of Thirst	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.4 Exhaustion Due to Exposure	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.5 Exhaustion Due to Excessive Exertion	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.6 Motion Sickness	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
994.8 Electrocution and Non Fatal Effects of Electric Current	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS

DMMPO ICD-9 codes	Trauma category	Anatomical location
995 Other Anaphylactic Shock Not Elsewhere Classified	SYSTEM WIDE & LATE EFFECTS	SYSTEM WIDE & LATE EFFECTS
E991.2 Injury Due to War Ops from Other Bullets (not rubber/pellets)	Matched Directly to Empirical Data	#N/A
E991.3 Injury Due to War Ops from Antipersonnel Bomb Fragments	Matched Directly to Empirical Data	#N/A
E991.9 Injury Due to War Ops other Unspecified Fragments	Matched Directly to Empirical Data	#N/A
E993 Injury Due to War Ops by Other Explosion	Matched Directly to Empirical Data	#N/A

Note. FRAC CL = closed fracture; TBI = traumatic brain injury; VCI = vertebral column injury; SCI = spinal cord injury; FRAC OP = open fracture.

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14. ABSTRACT

Medical planners often use modeling and simulation programs to obtain statistically valid estimates for medical services, equipment, and supplies. The Joint Services Capabilities Plan requires that each Service provides, and periodically updates, their respective patient condition occurrence frequency (PCOF) tables that are used for requirements estimation. Accordingly, the Assistant Secretary of Defense for Health Affairs (ASD/HA), Force Health Protection & Readiness (FHP&R), commissioned the development of Joint PCOF tables to be developed by all services for FY11.

This technical report describes the methodology that was used to estimate the occurrence rates of the condensed 336 Defense Medical Material Program Office *International Classification of Diseases*, 9th Revision, codes. These diagnostic codes comprise the Joint Services PCOF tables. These PCOF tables are provided by casualty type (wounded-in-action, nonbattle injury, disease, and combat stress casualties) and for three different scenarios. The use of recent empirical data establishes an updated baseline for estimating future medical needs on the battlefield. The results of this study will be provided to ASD/HA, FHP&R to help plan future medical force requirements.

15. SUBJECT TERMS
medical planning factors, patient condition occurrence frequencies, casualty rates, Defense Medical Standardization Board

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